

superfluous in United States patent practice and possibly confusing to the reader.

In response to the rejection under 35 U.S.C. 112 second paragraph correct Markush format has been implemented. The rejection of claims 1-4, 6-11, 13-18 and 20, as filed, under 35 U.S.C. 102(b) as anticipated by Norio et al. (Norio) or, in the alternative, under 35 U.S.C. 103 as obvious per se over Norio, is hereby respectfully traversed.

Applicant's invention provides a semi-conductor package having a heat sink 31 attached to leads on the leadframe structure in the package by a heat-conductive, electrically-insulative resin, so as to provide an additional heat conduction path to the heat sink and eliminate the need to encapsulate the heatsink. This attachment of the heat sink to the leads can also eliminate the risk of delamination between the heat sink and the encapsulant and permit semi-conductor packages that contain heat sinks to be thinner, because the heat sink need not be encapsulated.

In contrast, the structure described with reference to "drawing 8" Norio in the computer translated text of the publication provided with the Office Action, like the conventional EDHS structure described on page 2 of the application with reference to U.S. Pat. No. 5,381,042 (the '042 patent), lacks applicant's claimed structure and its advantages. Specifically, both Norio and the '042 patent disclose that their heat sinks are encapsulated. Furthermore Norio does not attach the heat sink to leads with adhesive, as recited in applicant's claims. Norio discloses neither that attachment, nor the thermally conductive and electrically insulating adhesive glue that is recited in applicant's claim.

Furthermore, it is advantageous not to have to encapsulate the heat sink. Encapsulating the heat sink is rendered, unnecessary since applicant's invention integrates the heat sink with the rest of the package, attaching the heat sink to leads instead. Applicant's heat sink is advantageously attached to the package, whether or not the heat sink is attached

to the die pad in the package, in a way that eliminates the need for deflashing the package, in addition to reducing the prior art delamination and thickness problems noted above. This is discussed on page 4, lines 16-31, and illustrated by the embodiment in Fig. 6, in particular.

Thus, nothing in Norio discloses or suggests applicant's invention as claimed in the application as filed. Norio is inapposite and, instead, reflects the problematic prior art practices distinguished from packages in accordance with the invention in the application itself. Moreover, heat sinks are conventionally attached to the package by encapsulation instead of attaching them to leads in the package. Thus the Norio patent, which does encapsulate the heat sink, also teaches away from applicant's invention.

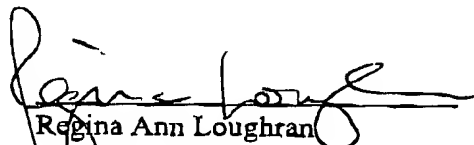
The rejection of claims 5, 12, and 19, as filed, under 35 U.S.C. 103 as obvious over Norio et al. in view of Yamashita, is hereby respectfully traversed for the reasons given above with reference to Norio. However, applicant also respectfully points out that Yamashita discloses a flexible, ribbon-type semi-conductor device, which does not have the "cavity-down lead frame" recited in the claims rejected in view of Yamashita. The ribbon or "film-carrier-type" semi-conductor devices, such as the one disclosed by Yamashita do not have a leadframe because leads are bonded directly to the chip, as noted in col. 4, lines 10-26.

Moreover,, the heat radiator element in Yamashita relied upon by the Office Action is attached to a "heat spreader" but neither the heat radiator and heat spreader combination nor the heat radiator itself is attached to the leads in any of the structures shown by Yamashita unlike the structures recited applicant's claims, as filed. Furthermore, Yamashita is directed to preventing mechanical stresses from cracking of the die in the flexible ribbon, rather than delamination of the encapsulant from other structures in the semiconductor package by thermal stress. Additionally, Yamashita also does not address the problem of flashing, nor the problem of fitting a heat sink inside a mold when making thin molded semiconductor

packages. Therefore, Yamashita neither discloses nor suggests the claimed features of applicant's invention or their advantages.

For the reasons given above it is believed that the application is now in condition for allowance and prompt action to that end is earnestly solicited.

Respectfully submitted,



Regina Ann Loughran
Reg. No. 30958

Ladas & Parry
26 West 61st Street
New York, New York 10023
(212) 708-1802

U013803-1

#7

SEMICONDUCTOR PACKAGE FOR ENHANCING HEAT DISSIPATION**BACKGROUND OF THE INVENTION****1. Field of the invention**

The present invention relates to a heat-dissipation-enhanced semiconductor package[, and]. More particularly, the present invention is directed to a heat-dissipation-enhanced semiconductor package [which could be applied in a thin product] for reducing the probability of [product's] delamination occurring, and the number of steps [of] in the manufacturing process.

2. Description of the related art

For [the technology of] a semiconductor package, [how to efficiently resolve] the problem of heat dissipation is a very important issue. A semiconductor package with bad heat dissipation [could not only create a series of] may not just produce errors, but may also reduce [the] product reliability and greatly increase [much] manufacturing cost.

FIG. 1 shows [a prior art] the DHS (Drop-in Heat Sink) structure of a semiconductor package disclosed in U.S. Patent No. 5,22,710. The [package] package's structure comprises: a die pad 14; a die 12, which is [mounted] attached to a first surface 141 of the die pad 14 with a [die attach] suitable adhesive 15, such as a silver paste; a plurality of leads 13[, which are] electrically connected to an active surface 121 of the die 12 [with] by a plurality of bonding wires 17, such as gold wires; [the] a heat sink 16 and an encapsulant 11. The die pad 14 and the plurality of leads 13 are all a part of a leadframe [; a heat sink 16, which is located inside the lower mold 19 and]and are placed inside an upper mold 18 during manufacture. The heat sink 16 is located inside a lower mold 19, and one surface of the heat sink 16 contacts the bottom of the lower mold 19 with [contacts] points 161 and 162[, and another],

U013803-1

Another surface of the heat sink is attached to the second surface 142 of the die pad 14[; and an].

An encapsulant 11[, which] is injected to fill the molding cavity [of] left by the package structure when the upper mold 18 and lower mold 19 are closed. The [characteristic of the prior art package structure is that the] heat generated by the die 12 [could be] in the DHS package is characteristically dissipated from the die pad 14, through the heat sink 16 attached to the die pad 14 and then to the atmosphere.

FIG. 2 [is a prior art] shows the EDHS (Exposed Drop-in Heat Sink) structure of a semiconductor package disclosed in U.S. Patent No. 5,381,042. The difference [of] between the EDHS structure [from] and the DHS structure is that in the EDHS structure a heat sink 21 with a flat bottom [in the EDHS structure] is directly exposed to the bottom of the semiconductor package, unlike the heat sink 16 of the DHS structure [contacting], which contacts the bottom of the semiconductor package through the [contacts] points 161 and 162. The exposed surface drop-in heat sink 21 [has] provides a larger contact area than the drop-in heat sink 16 to dissipate [the] heat. Therefore, [the effect of] heat dissipation in the EDHS structure is [better] more effective than that in the DHS structure. However [But] both the DHS and the EDHS [structure] structures have the following disadvantages:

1. During the DHS 16 and EDHS 21 manufacturing processes, the heat sink [should be] is put inside the lower mold 19 first, and the die pad 14 [is] then aligned to the heat sink. In other words, an extra [process] step is added, which increases the cycle time of the manufacturing process [is increased, and thus the throughput is reduced.], and thus reduces the throughput.

- [2. The drop-in heat sink 16 or the exposed drop-in heat sink 21 is] 2: The DHS 16

U013803-1

and EDHS 21 packages are covered by the encapsulant 11, but both [the] heat sinks [and the encapsulant] have [different] a CTE (Coefficient of Thermal Expansion)[. When the structure suffers from] that is different from that of the encapsulants. Therefore, when temperature changes cause expansion and shrinking, the effect of this thermal stress [will be created] on the contact surface between the heat sink and the encapsulant[, and] will cause delamination [will be created on the] of that contact surface. [Besides,] Moreover, in both examples, because the amounts of [the] encapsulant 11 inside the upper mold 18 and lower mold 19 are not the same, [and] the package structure will [be warped due to different shrinking strengthes after being cooled. The moisture in the atmosphere will permeate into cracks caused by] also be warped after it cools, due to the different amounts of shrinking produced by the different amounts of encapsulant. Moisture in the atmosphere can enter the package through cracks caused by either delamination or warping[, and]; therefore, the reliability of the delaminated or warped semiconductor package [will be] is reduced.

3. [Besides, when the encapsulate] When the encapsulant 11 is injected into the closed mold, the heat sink 21 is [fixed] attached by four tie bars on the diagonals of the leadframe (not shown). As the strength of the four tie bars [are] is not necessarily [large] great enough to [fix] hold the heat sink 21 in place, some flashed encapsulant will be left on the bottom of the semiconductor package after encapsulation. The manufacturing cost [will be increased because a deflashing action should be taken.] of these packages is also increased by the additional deflashing step required to correct that.

[4. In the above two prior arts, the] 4. In use, the known semiconductor packages described above provide heat dissipation paths [start] extend from the die 12, through the die pad 14, [then through] to the heat sinks 16 or 21, and finally to the atmosphere [at last.

U013803-1

Because the] These heat dissipation paths are too limited [; for example,] because the plurality of leads [cannot be] are not used for dissipating the heat, reducing the efficiency of [the] their heat dissipation [will be reduced].

[5. For some] 5. Finally, thin products[,] such as some consumer [IC whose thickness P is less than 1.00mm (in other words, the thickness of] ICs, where the thickness of the package ("P" in Figs. 1 and 2) is less than 1.00mm, the thickness of the space in the lower mold is less than 0.45mm(), the heat sink 16 or 21] as shown in Figs. 1 and 2. Therefore, the heat sinks 16 or 21 shown in Figs. 1 and 2 cannot be put inside [the] such a thin package [due to small thickness].

SUMMARY OF THE INVENTION

The [first object of the] present invention [is to propose] provides a semiconductor package which [has no] eliminates the need to put a heat sink inside the[,] lower mold before [it] the package is encapsulated. A semiconductor package constructed in accordance with [The second object of] the present invention [is to propose a semiconductor package which will not cause delamination due to different CTE between] reduces the delamination caused by a difference in the CTE's of the encapsulant and the heat sink. [

]The [third object of the present invention is to propose a semiconductor package which has no need to process] invention eliminates the need for a deflashing process and permits[.

The fourth object of the present invention is to propose a semiconductor package which could use] a plurality of leads to be used for dissipating the heat generated by the die. [

]The [fifth object of the present] invention [is to propose] provides a semiconductor package [which could be applied in] that is suitable for a thin product, such as a TQFP (Thin Quad Flat Package) or a TSOP (Thin Small Outline Package).

U013803-1

[For achieving the above purposes, the present invention discloses] In a particular embodiment of a semiconductor package [for enhancing heat dissipation. Only] in accordance with the present invention, only the contents of the upper mold is encapsulated[, and a heat sink having a thickness variable with demands is mounted]. The heat sink is attached to the die pad and to a part of the plurality of leads with a thermally conductive and electrically insulating adhesive glue.

[As] In accordance with the invention, the thickness of the heat sink is adjustable [according to user's demands, and] to suit the user's demands. In particular, in accordance with the invention, the heat sink is not limited by the thickness specification of the lower mold in [prior art] and, therefore, the present invention is more [suitable] advantageous for manufacturing thin products.

[The] Since the width of the heat sink covers both the die pad and a part of the plurality of leads, [therefore] the heat generated by the die [could] can be dissipated not only [dissipated] to the atmosphere but also through the heat [sink and leadframe, but also dissipated through the heat sink and] and the leads sink to the printed circuit board [mounted to the leads of the leadframe by conduction. In manufacturing process of the semiconductor package for enhancing heat dissipation, there is no need to be aligned accurately] attached to the leads. Furthermore, because of the width of the heat sink, there is no need for precise alignment between the die pad and the heat sink[, and]. There is also no need [to pressure the heat sink by] for the tie bars of the leadframe[,] to exert pressure on the heat sink, and therefore the cycle time of the manufacturing process [would be] is reduced[, and [the] throughput [would be raised. Besides,] is increased.

Moreover, because the heat sink according to the present invention is not encapsulated

U013803-1

inside the lower mold, but [mounted to the die pad and a part of the plurality of] attached to some of the leads with an adhesive glue[, therefore] instead, even though the CTEs of the heat sink and encapsulant or the leadframe and encapsulant are not the same, the encapsulant will not be cracked or delaminated when [the structure suffers from] structural expansion and shrinking[, and] occurs. Thus, the reliability of products using the semiconductor package [will be raised. Finally, even the flash is created] is increased.

Finally, because the heat sink is not encapsulated, unsightly flash left when encapsulating the upper mold[, and the bad appearance] will be hidden [after mounting] when the heat sink is attached to the die pad [and a part of the plurality of leads. In other words,] in accordance with the present invention [would avoid the]. This eliminates the need for a deflashing step in [prior art.] the manufacturing process.

[The] A first embodiment of the semiconductor package for enhancing heat dissipation [according to] in accordance with the present invention [mainly] comprises a die, a leadframe, an encapsulant and a heat sink. The leadframe includes a die pad having a first surface [which] that the die is [mounted] attached to and a plurality of leads electrically connected to an active surface of [said die through a plurality of bonding wires] the die. The encapsulant is used to seal said die and leadframe. The heat sink is [mounted] attached to the second surface of the die pad [and], and at least a portion of a surface of leads in the plurality of leads, with a thermally conductive and electrically insulating adhesive glue.

[The] In a second embodiment of the semiconductor package for enhancing heat dissipation according to the present invention [mainly comprises a die, a leadframe, an encapsulant and a heat sink. The], the die includes an active surface and a second surface[. The], and the leadframe includes a central-hole die pad and a plurality of leads[, wherein the]

U013803-1

The central-hole die pad has a first surface [which] that the die is [mounted] attached to and a second surface. The plurality of leads are electrically connected to the active surface of the die [through a plurality of bonding wires. The encapsulant is used to seal the die and leadframe]. The heat sink is a T-type structure[, mounted] attached to the second surface of the die, to the second surface of the die pad and to at least a portion of a surface of leads in the plurality of leads with a thermally conductive and electrically insulating adhesive glue.

[The] In a third embodiment of the semiconductor package for enhancing heat dissipation according to the present invention [mainly comprises a die, a leadframe, an encapsulant and a heat sink. The] the die includes an active surface. The leadframe includes a plurality of leads [for mounting the die and a plurality of leads] electrically connected to an active surface of the die [through a plurality of bonding wires. The encapsulant is used to seal the die and leadframe. The heat sink is mounted to]. The heat sink is attached to at least a portion of a surface of leads in the plurality of leads with a thermally conductive and electrically insulating adhesive glue.

[The] A manufacturing method [of] for the first embodiment [of the semiconductor package for enhancing heat dissipation according to the present invention mainly comprises steps (a) to (d). In step (a), the die is mounted to the] comprises at least the steps of: (a) attaching the die to a first surface of the die pad, [and the plurality of bonding wires are used to electrically connect the] so that an active surface of the die [and] is electrically connected to the plurality of leads[. In step (b),]; (b) adding encapsulant to an upper mold for sealing the die and leadframe [is encapsulated. In step (c),]; (c) attaching the heat sink [is mounted] to the second surface of the die pad and [a part of] to at least a portion of the surface of leads in the plurality of leads with the thermally conductive and electrically insulating adhesive glue[. In

U013803-1

step (d), the leadframe is formed and singulated.]; and (d) forming and singulating the leadframe.

[The] A manufacturing method [of] for the second embodiment [of the semiconductor package for enhancing heat dissipation according to the present invention mainly comprises steps (a) to (d). In step (a), the die is mounted to the] at least comprises the steps of: (a) attaching the die to a first surface of the die pad[, and the plurality of bonding wires are used to electrically connect the] so that an active surface of the die [and the] is electrically connected to a plurality of leads]. In step (b).]; (b) adding encapsulant to an upper mold for sealing the die, a and leadframe [is encapsulated. In step (c).]; (c) attaching the heat sink [is mounted] to [the] a second surface of the die, [the] a second surface of the die pad and [a part of the] at least a portion of the surface of leads in a plurality of leads with [the] a thermally conductive and electrically insulating adhesive glue]. In step (d), the leadframe is formed and singulated.], and (d) forming and singulating the leadframe.

[The] A manufacturing method [of] for the third embodiment [of the] semiconductor package for enhancing heat dissipation according to the [present invention mainly comprises steps (a) to (d). In step (a), a die is mounted] invention comprises at least the steps of: (a) electrically connecting an active surface of a die to the plurality of leads[, and the plurality of bonding wires are used to electrically connect the active surface of the die and the plurality of leads. In step (b), only the]; (b) adding encapsulant to an upper mold for sealing said die and [leadframe is encapsulated. In step (c), the heat sink is mounted to a part of] a first portion of a surface on the leads; and (c) attaching the heat sink to a second portion of the surface of leads in the plurality of leads with the thermally conductive and electrically insulating adhesive glue. [In step (d), the leadframe is formed and singulated.]

U013803-1

BRIEF DESCRIPTION OF THE DRAWINGS

The invention [will be] is described [according] below with reference to the appended drawings, in which:

FIG. 1 [is] shows a prior art DHS [structure of a] semiconductor package;

FIG. 2 [is] shows a prior art EDHS [structure of a] semiconductor package;

FIGS. 3(a) to 3(d) show [semi-products manufactured by a manufacturing process of] semiconductor products in various stages of a manufacture in accordance with the present invention;

FIG. 4 shows [an embodiment of] a cavity-down package structure [according to] in accordance with the present invention;

FIG. 5 shows [an embodiment of a] a first cavity-up package structure [according to the] in accordance with present invention; and

FIG. 6 shows [another embodiment of a] a second cavity-up package structure [according to] in accordance with the present invention.

[PREFERRED EMBODIMENT OF THE PRESENT INVENTION] DETAILED
DESCRIPTION OF PREFERRED EMBODIMENTS

FIGs. 3(a) to 3(d) show [semi-]semiconductor products manufactured [by the manufacturing process of] in accordance with the present invention. [As shown in] In FIG. 3(a), a die 12 is [mounted] attached to a first surface 141 of the die pad 14 [first], and [the wiring] then wire bonding is [processed] provided between the active surface 121 of the die 12 and a plurality of leads 13. Afterwards, only the upper mold 18 is encapsulated.

[As shown in] In FIG. 3(b), after the encapsulation of the upper mold 18, as shown in Fig. 3(a), a heat sink 31 is [mounted] attached to the second surface 142 of the die pad 14 and

U013803-1

to a portion of the surface of a part of the plurality of leads 13 with adhesive glue 32. The thickness of the heat sink 31 [could be suitably chosen according to the specification of] can be a thickness that is suitable for the thin product. Therefore, the limitation in prior art that the thickness of the heat sink should be less than that of the lower mold [can be avoided in] does not apply to products manufactured in accordance with the present invention.

The adhesive glue 32 should be a thermally conductive but not electrically conductive one, such as well-known epoxy, B-stage epoxy or silicone adhesives, and the present invention [does not limit the kind of the] is not limited to these materials. If a well-known B-stage epoxy, which is half-dry at about 50°C, is used as the adhesive glue, the heat sink 31 will be firmly [mounted] attached to the die pad 14, the encapsulant 11 and a part of the plurality of leads 13 due to high pressures and high temperatures in the manufacturing process, as is well-known in the art. The material of the heat sink 31 could be made of the well-known copper, copper alloy materials, aluminum or aluminum alloy, and the present invention [does not limit the kind of the] is not limited to these materials.

[As shown in] In FIG. 3[(c)](c), after the heat sink 31 [mounted to] is attached to the die pad and to leads that were partially encapsulated in the upper mold 18, a forming step [is executed to bend] bends the plurality of leads 13 towards the heat sink 31, and a singulating step [is executed to cut] cuts off the four tie bars (not shown) [of] on the leadframe.

However, [The structure] in FIG. 3(c) [is to bend] the plurality of leads are bent towards the heat sink 31 in the forming step, so as to form a so-called "cavity-up" type [""] of package.

[Another structure] In contrast to FIG. 3(c), in FIG. 3[(d)](d) is to warp](d) the plurality of leads [towards the direction of] are bent toward the upper mold 18 in forming step, so as to form a [so called]"cavity-down" type [""] of package.

U013803-1

FIG. 4 shows an embodiment of a cavity-down package structure according to the present invention. In [the structure of] FIG. 4, the top of the heat sink 31 [is further added a] has an additional heat radiator 41 for dissipating the heat generated by the die 12 to the atmosphere by convection and radiation.

FIG. 5 shows [an] a further embodiment of a package structure according to the present invention. [The difference between the embodiment in FIG. 4 and that in FIG. 5 is that] Unlike FIG. 4, in FIG. 5 the die pad 14 is a central-hole type[, means] of die pad that is the die pad 14 [could be] is split into two parts [and left] leaving a central hole. The advantage of [the] this design is [to reduce] that it reduces the probability of delamination between the die 12 and the die pad 14. [The] Thus, the heat sink 31 [could] may be a T-shaped structure. After the encapsulation of the upper mold 18, the heat sink 31 is [mounted] attached to the second surface 122 of the die 12, the die pad 14 and the leads 13[, and]. After that, the manufacturing process is finished by the forming step and the singulating step.

FIG. 6 shows another embodiment of a package structure according to the present invention. [The difference from] Unlike the [above] other two embodiments [is that the] this package structure does not have a die pad. Instead, the die 12 is adhered to a portion of the surface of the leads 13 with die [attach] adhesive 15, as shown. The design is suitable [to a leadframe mounted to the] for a die of any [sizes] size. As shown in FIGs. 3(b) and 3(c), after the encapsulation [of] in the upper mold of a portion of the surface of the leads, the heat sink 31 is [mounted to a part] attached to another portion of the [plurality] surface of the leads by the adhesive glue 32, and the manufacturing process is finished by the forming and singulating steps described above.

U013803-1

Since the [

The] heat sink 31 constructed according to the invention is not inside the encapsulation[. Therefore,] material, even if the CTEs of the heat sink 31 and the [encapsulation] encapsulant are not the same, [and the disadvantage of] delamination will to not occur [due to the use of] because the adhesive glue serves as a buffering layer. [Besides] Therefore, cracks due to thermal stress [would] are not [be] created[. Therefore,], and the reliability of the package according to the present invention [could be raised.] is improved. Furthermore, [the] when encapsulation [is performed] occurs only in the upper mold[. Therefore], there is no need to [conduct a deflashing step as in the prior art because there is no flash on the heat sink] provide a deflashing step. No flash can be deposited on the heat sink because it isn't present during the encapsulation step in accordance with the invention. Although the bottom of the upper mold 18 [would leave behind flash, the problem would be eliminated after the upper mold is mounted to the heat sink 31] may produce flash, after the heat sink 31 is attached to the encapsulated portion of the package with the adhesive glue 32 that flash is covered, and the appearance and function of the semiconductor package according to the present invention [will] are not [be] affected by that flash. In addition, [as] because the die 12 and leads in the plurality of leads 13 are [mounted] attached to the heat sink 31 with a thermally conductive adhesive glue 32, [another] an additional heat dissipation path is [formed and starts] provided from the die 12[,] through the die pad 14, the heat sink 31, and the [plurality of] leads 13, [and] to the printed circuit board (not shown) on which the package is [mounted] attached, in addition to the prior art path from the die 12[,] through the die pad 14[,] and the heat sink 31, [and] to the atmosphere.

The [present invention does not limit the kind of the semiconductor packages, but is

U013803-1

most suitable to the semiconductor packages of TQFP and TSOP.

The] above-described embodiments [-]of the present invention are [intended to be illustrated only.]provided for the purpose of illustration, only. The present invention is well-suited for producing semiconductor packages of the TQFP and TSOP, types but it is not limited to those types of packages. Numerous alternative embodiments may be devised by those skilled in the art without departing from the spirit and scope of the [following] invention, which is defined by the claims.

U013803-1

What is claimed is:

1. A semiconductor package for enhancing heat dissipation, comprising:
 - a die [including] having an active surface;
 - a leadframe, including:
 - a die pad having a first surface and a second surface, said die being [mounted on] attached to said first surface of the die pad; and
 - a plurality of leads electrically connected to the active surface of said die [through a plurality of bonding wires;], said leads having a surface.
 - [an encapsulant for sealing an upper mold containing said die and]an encapsulant sealing said die and at least a portion of the surface of the leads in said leadframe; and
 - a heat sink [mounted] attached to the second surface of said die pad and [the]at least a portion of the surface of leads in said plurality of leads with a thermally conductive and electrically insulating adhesive glue.
2. The semiconductor package of Claim 1, wherein said heat sink is made of material selected from the group consisting of copper, copper alloy, aluminum or aluminum alloy.
3. The semiconductor package of Claim 1, wherein said adhesive glue is [made] selected from the group consisting of epoxy, B-stage epoxy or silicone.
4. The semiconductor package of Claim 1, wherein said leadframe is of a cavity-up or cavity-down type of leadframe.
5. The semiconductor package of Claim 4, wherein said heat sink further comprises a heat radiator on its top [if] and said leadframe is [of] a cavity-down type of leadframe.
6. The semiconductor package of Claim 1, manufactured by steps of:

U013803-1

[
(a) [mounting] attaching said die to the first surface of said die pad and [using the plurality of bonding wires to] electrically [connect] connecting the active surface of said die [and] to the plurality of leads;

(b) [encapsulating] adding encapsulant to an upper mold for sealing said die and [said leadframe formed by the die and the] one portion of the surface of said plurality of leads;

(c) [mounting] attaching said heat sink to the second surface of said die pad and [a part of the] at least another portion of the surface of leads in said plurality of leads with the thermally conductive and electrically insulating adhesive glue; and

(d) forming and singulating said leadframe.

7. The semiconductor package of Claim 6, wherein in step (d), said leadframe is [of] a cavity-up or cavity-down type of leadframe.

8. A semiconductor package for enhancing heat dissipation, comprising:

a die [including] having an active surface and a second surface;

a leadframe, including:

a central-hole die pad having a first surface and a second surface, said first surface being [mounted] attached to said die; and

a plurality of leads electrically connected to the active surface of said die [through a plurality of bonding wires;] said leads having a surface;

[an encapsulant for sealing an upper mold containing] an encapsulant sealing one portion of the surface of said plurality of leads in said die and leadframe; and

a heat sink [of] having a T-type structure, [mounted] said heat sink being attached to the second surface of said die, the second surface of said die pad and [the] at least another

U013803-1

portion of the surface of leads in said plurality of leads with a thermally conductive and electrically insulating adhesive glue.

9. The semiconductor package of Claim 8, wherein said heat sink is made of a material selected from the group consisting of copper, copper alloy, aluminum or aluminum alloy.

10. The semiconductor package of Claim 8, wherein said adhesive glue is made of selected from the group consisting of epoxy, B-stage epoxy or silicone.

11. The semiconductor package of Claim 8, wherein said leadframe is of a cavity-up or cavity-down type of leadframe.

12. The semiconductor package of Claim 11, wherein the top of said heat sink further comprises a heat radiator [if and said leadframe is [of] a cavity-down type of leadframe.

13. The semiconductor package of Claim 8, manufactured by steps of:

(a) [mounting] attaching said die to the first surface of said die pad, and [using the plurality of bonding wires to] electrically [connect] connecting the active surface of said die [and] to the plurality of leads;

(b) [encapsulating] adding an encapsulant to an upper mold for sealing said die and [said leadframe formed by the die and the] one portion of the surface of said plurality of leads;

(c) [mounting] attaching said heat sink to the second surface of said die, the second surface of said die pad and [a part of the] at least another portion of the surface of leads in said plurality of leads with a thermally conductive and electrically insulating adhesive glue; and

(d) forming and singulating said leadframe.

U013803-1

14. The semiconductor package of Claim 13, wherein in step (d), said leadframe is of a cavity-up or cavity-down type leadframe.

15. A semiconductor package for enhancing heat dissipation, comprising:
a die [including] having an active surface;
a [leadframe including a plurality of leads for mounting said die, and
the] plurality of leads electrically connected to the active surface of said die [through a
plurality of bonding wires;] said leads having a surface;

[an encapsulant for sealing an upper mold containing said die and leadframe; and an
encapsulant sealing said die and one portion of the surface of said leads; and

[a heat sink mounted to the a heat sink attached to at least another portion of the
surface of leads in said plurality of leads with a thermally conductive and electrically
insulating adhesive glue.

16. The semiconductor package of Claim 15, wherein said heat sink is made of a
material selected from the group consisting of copper, copper alloy, aluminum or aluminum
alloy.

17. The semiconductor package of Claim 15, wherein said adhesive glue is made of
selected from the group consisting of epoxy, B-stage epoxy or silicone.

18. The semiconductor package of Claim 15, wherein said leads are a part of a
leadframe [is] of a cavity-up or cavity-down type.

19. The semiconductor package of Claim 18, wherein the top of said heat sink further
comprises a heat radiator [if said leadframe is and said plurality of leads is a part of a
cavity-down type of leadframe].

20. A method of manufacturing a

U013803-1

20. The] semiconductor package [of Claim 15, manufactured by steps of:] comprising the steps of:

[(a) mounting said die to the plurality of leads, and using the plurality of bonding wires to electrically connect](a) electrically connecting the active surface of [said] a die [and the] to a plurality of leads;

(b) [encapsulating the] adding encapsulant to an upper mold for sealing said die and [said leadframe formed by the die and the] one portion of the surface of leads in said plurality of leads; and

(c) [mounting] attaching said heat sink to [a part of the] another portion of the surface of at least some leads in said plurality of leads with thermally conductive and electrically insulating adhesive glue[; and(d) forming and singulating said leadframe].

U013803-1

SEMICONDUCTOR PACKAGE FOR ENHANCING HEAT DISSIPATION**ABSTRACT OF THE DISCLOSURE**

The present invention discloses a semiconductor package for enhancing heat dissipation. Only [an upper mold] the structures of the semiconductor package [is encapsulated, and a heat sink having a thickness variable with demands is mounted to a die pad and a part of a plurality of leads with]that conventionally located in one of the two parts of the mold conventionally used to encapsulate a semiconductor package are encapsulated. A heat sink of the desired thickness is then attached to leads in the plurality of leads connected to the encapsulated die and possibly also to the die pad or leadframe with a thermally conductive and electrically insulating adhesive glue. As the thickness of the heat sink [is adjustable] can be freely varied according to user's [demands] needs, the present invention is [more suitable] advantageous for manufacturing thin [products. The] packages. Since the width of the heat sink covers the die pad and a part of the plurality of leads[. Therefore], the heat generated by the die [could be] is not only dissipated to the atmosphere [through the leadframe, but also dissipated through a printed circuit board] from the heat sink connected to the leads of the leadframe to the air, but also dissipated through the printed circuit board connected to the leads of the leadframe to the air.